

WHAT IS CLAIMED IS:

1. An image processing method comprising:
 - a first pixel block sampling step of recursively sampling black pixel blocks and white pixel blocks from a binary image;
 - a tree structure creating step of creating tree structure data indicating a positional relation between the black pixel blocks and white pixel blocks sampled in said first pixel block sampling step;
 - an inverted image creating step of creating an inverted image by white-black-inverting the insides of black pixel blocks that can include inverted characters, of black pixel blocks included in said tree structure data;
 - a second pixel block sampling step of sampling white pixel block and black pixel blocks from the inverted image created in said inverted image creating step; and
 - a tree structure addition step of adding data regarding the white pixel blocks and black pixel blocks sampled in said second pixel block sampling step to corresponding nodes of said tree structure data.
2. The image processing method according to claim 1, wherein for the data regarding the white pixel blocks and black pixel blocks added in said

tree structure addition step, data regarding white pixel blocks having data regarding the sampled black pixel blocks as child nodes is added as child nodes of the white-black-inverted black pixel blocks of
5 said tree structure data.

3. The image processing method according to claim 1, wherein in said inverted image creating step, said inverted image is created by white-black
10 inverting the pixels inside the black pixel blocks sampled in said first pixel block sampling step with the outline of the black pixel blocks constituted by black pixels.

15 4. The image processing method according to claim 1, further comprising an area division step of dividing said binary image into a plurality of areas by grouping black pixel blocks based on the tree structure data with data regarding white pixel blocks
20 and black pixel blocks added in said tree structure addition step.

5. The image processing method according to claim 1, further comprising an area tree structure
25 creating step of creating area tree structure data indicating a positional relation between a plurality of areas by grouping black pixel blocks based on the

tree structure data with data regarding white pixel blocks and black pixel blocks added in said tree structure addition step.

5 6. The image processing method according to claim 1, wherein said black pixel block is an area surrounded by a black pixel outline obtained by performing eight direction outline tracking of black pixels, and said white pixel block is an area
10 surrounded by white pixel outline obtained by performing four direction outline tracking of white pixels.

 7. The image processing method according to
15 claim 1, wherein said binary image is an image obtained by subjecting a binary original image to OR scaledown, and

 said inverted image is created based on the area of black pixel blocks to be white-black-inverted
20 and an image obtained by white-black inverting said original image and subjecting the same to OR scaledown.

 8. The image processing method according to
25 claim 1, wherein in said inverted image creating step, an inverted image for black pixel blocks of low black pixel density, of black pixel blocks included in said

tree structure data, is not created.

9. The image processing method according to claim 1, wherein the black pixel blocks sampled in
5 said second pixel block sampling step are black pixel blocks remaining after removing black pixel blocks sampled from said inverted image that are located at positions corresponding to white pixel blocks each having a predetermined size or greater size, of white
10 pixel blocks sampled from said binary image, from a plurality of black pixel blocks sampled from said inverted image.

10. The image processing method according to
15 claim 1, wherein in said second pixel block sampling step, it is determined that black pixel blocks from which the inverted image is created include no inverted characters to end processing if the ratio of black pixel blocks originating from noises to a
20 plurality of black pixel blocks extracted from said inverted image equals a predetermined value or greater value.

11. The image processing method according to
25 claim 7, wherein said binary original image is an image converted by binarizing a multi-valued original image.

12. An image processing apparatus comprising:
first pixel block sampling means for
recursively sampling black pixel blocks and white
pixel blocks from a binary image;

5 tree structure creating means for creating tree
structure data indicating a positional relation
between the black pixel blocks and white pixel blocks
sampled by said first pixel block sampling means;

inverted image creating means for creating an
10 inverted image by white-black-inverting the insides
of black pixel blocks that can include inverted
characters, of black pixel blocks included in said
tree structure data;

second pixel block sampling means for sampling
15 white pixel block and black pixel blocks from the
inverted image created by said inverted image
creating means; and

tree structure addition means for adding data
regarding the white pixel blocks and black pixel
20 blocks sampled by said second pixel block sampling
means to corresponding nodes of said tree structure
data.

13. The image processing apparatus according to
25 claim 12, wherein for the data regarding the white
pixel blocks and black pixel blocks added by said
tree structure addition means, data regarding white

pixel blocks having data regarding the sampled black pixel blocks as child nodes is added as child nodes of the white-black-inverted black pixel blocks of said tree structure data.

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14. The image processing apparatus according to claim 12, wherein said inverted image creating means creates said inverted image by white-black inverting the pixels inside the black pixel blocks sampled by
10 said first pixel block sampling means with the outline of the black pixel blocks constituted by black pixels.

15. The image processing apparatus according to
15 claim 12, further comprising area division means for dividing said binary image into a plurality of areas by grouping black pixel blocks based on the tree structure data with data regarding white pixel blocks and black pixel blocks added by said tree structure
20 addition means.

16. The image processing apparatus according to claim 12, further comprising area tree structure creating means for creating area tree structure data
25 indicating a positional relation between a plurality of areas by grouping black pixel blocks based on the tree structure data with data regarding white pixel

blocks and black pixel blocks added by said tree structure addition means.

17. The image processing apparatus according to
5 claim 12, wherein said black pixel block is an area surrounded by a black pixel outline obtained by performing eight direction outline tracking of black pixels, and said white pixel block is an area
10 surrounded by white pixel outline obtained by performing four direction outline tracking of white pixels.

18. The image processing apparatus according to
claim 12, wherein said binary image is an image
15 obtained by subjecting a binary original image to OR scaledown, and

said inverted image is created based on the area of black pixel blocks to be white-black-inverted and an image obtained by white-black inverting said
20 original image and subjecting the same to OR scaledown.

19. The image processing apparatus according to
claim 12, wherein said inverted image creating means
25 does not create an inverted image for black pixel blocks of low black pixel density, of black pixel blocks included in said tree structure data.

20. The image processing apparatus according to claim 12, wherein the black pixel blocks sampled by said second pixel block sampling means are black pixel blocks remaining after removing black pixel blocks sampled from said inverted image that are located at positions corresponding to white pixel blocks each having a predetermined size or greater size, of white pixel blocks sampled from said binary image, from a plurality of black pixel blocks sampled from said inverted image.

21. The image processing apparatus according to claim 12, wherein said second pixel block sampling means determines that black pixel blocks from which the inverted image is created include no inverted characters to end processing if the ratio of black pixel blocks originating from noises to a plurality of black pixel blocks extracted from said inverted image equals a predetermined value or greater value.

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22. The image processing apparatus according to claim 18, wherein said binary original image is an image converted by binarizing a multi-valued original image.

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23. A computer executable image processing program comprised of codes for making a computer

perform:

a first pixel block sampling step of recursively sampling black pixel blocks and white pixel blocks from a binary image;

5 a tree structure creating step of creating tree structure data indicating a positional relation between the black pixel blocks and white pixel blocks sampled in said first pixel block sampling step;

an inverted image creating step of creating an
10 inverted image by white-black-inverting the insides of black pixel blocks that can include inverted characters, of black pixel blocks included in said tree structure data;

a second pixel block sampling step of sampling
15 white pixel block and black pixel blocks from the inverted image created in said inverted image creating step; and

a tree structure addition step of adding data regarding the white pixel blocks and black pixel
20 blocks sampled in said second pixel block sampling step to corresponding nodes of said tree structure data.

24. A storage medium including a computer
25 readable image processing program, the image processing program comprised of codes for making a computer perform:

a first pixel block sampling step of recursively sampling black pixel blocks and white pixel blocks from a binary image;

5 a tree structure creating step of creating tree structure data indicating a positional relation between the black pixel blocks and white pixel blocks sampled in said first pixel block sampling step;

10 an inverted image creating step of creating an inverted image by white-black-inverting the insides of black pixel blocks that can include inverted characters, of black pixel blocks included in said tree structure data;

15 a second pixel block sampling step of sampling white pixel block and black pixel blocks from the inverted image created in said inverted image creating step; and

20 a tree structure addition step of adding data regarding the white pixel blocks and black pixel blocs sampled in said second pixel block sampling step to corresponding nodes of said tree structure data.